TITLE OF THE INVENTION

CONNECTOR APPARATUS OF HARD DISK DRIVE

CLAIM OF PRIORITY

This application makes reference to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C. §119 from an application for *Connector Apparatus of Hard Disk Drive* earlier filed in the Korean Industrial Property Office on 14 June 1996 and there duly assigned Serial No. 21557/1996.

Field of the Invention

The present invention relates generally to a hard disk drive used as an auxiliary memory device for a computer, and more particularly, to a connector apparatus for connecting a printed circuit board to a head/disk assembly.

Background of the Invention

Commonly, a hard disk drive used as an auxiliary memory for a computer is made up of a head/disk assembly (commonly called HDA for short) and a printed circuit board assembly (commonly called PCBA for short) for controlling the head/disk assembly.

The head/disk assembly includes a spindle motor for revolving a magnetic disk at a regular speed, and an actuator serving as a carriage for actuating a head to read and write data to or from the magnetic disk. The printed circuit board assembly includes various kinds of electric circuits for controlling the spindle motor, the actuator, the head, and the like. Such a printed circuit board assembly is electrically connected to the head/disk assembly via a connector.

Further, the spindle motor, the actuator, and the head have respective input/output connectors for permitting a signal communication between the head/disk assembly and the printed circuit board assembly. For example, the signals communicated between the head/disk assembly and the printed circuit board assembly includes a current signal applied to U, V, and W-phases for the spindle motor and a voice coil motor, and a head signal for a read/write operation. Such signals are generally communicated through the connectors.

U.S. Patent No. 5,420,733 for an *Electrical Connector That Is Fastened to a Hard Disk Drive Housing by Pins That Extend From a Housing and are Inserted Into Corresponding Connector Apertures* to Knighton et al. and U.S. Patent No. 5,392,175 for a *PCMCIA Type HDD Connector Mount* to Beecroft each disclose connector pins used in the assembly process of a hard disk drive. U.S. Patent No. 5,500,779 for a *Disk Drive Memory Card Electrical Interconnect* to Diel discloses curved connectors used in the assembly of a hard disk drive. I have found that conventional design practice as represented by the foregoing references fail to provide connectors that automatically electrically couple the head/disk assembly to a printed circuit board when mounted together.

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SUMMARY OF THE INVENTION

It is therefore an object to provide a connector apparatus of a hard disk drive, in which an electrical connection between a head disk assembly and a flexible printed circuit board is automatically made upon mounting a printed circuit board on a head/disk assembly.

It is another object to provide a connector apparatus of a hard disk drive having an improved yield.

It is still another object to provide a connector apparatus of a hard disk drive, having a low inferior rate of manufactured goods.

According to an aspect of the present invention, a connector apparatus of a hard disk drive is made up of a printed circuit board including a multi-pin (*e.g.* a 4-pin) connector mounted thereon, and a head/disk assembly including a flexible printed circuit board mounted thereon, in which the multi-pin connector automatically contacts the flexible printed circuit board when combining the printed circuit board with the head/disk assembly.

The multi-pin connector includes a plurality of hooklike terminals for securing a firm contact with the flexible printed circuit board. The hooklike terminals each comprises a bent portion being elastically bent downward, thereby to prevent said flexible printed circuit board from being damaged.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of this invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following

detailed description when considered in conjunction with the accompanying drawings, in which like reference symbols indicate the same or similar components, wherein:

Fig. 1 is a schematic diagram showing a printed circuit board on which a 14-pin connector, integrated circuits, and a 4-pin connector are mounted according to the prior art;

Fig. 2 is an enlargement of A in Fig 1 showing the 4-pin connector;

Fig. 3 is a schematic diagram showing a head/disk assembly on which a 14-pin head and a flexible printed circuit board are mounted according to the prior art;

Fig. 4 is a schematic diagram showing a printed circuit board on which a 14-pin connector, integrated circuits, and a 4-pin connector are mounted according to an embodiment of the present invention;

Figs. 5A and 5B are an enlargement of 11 in Fig 4. Figs 5A and 5B are a cross-sectional view and a plan view respectively of the 4-pin connector according to an embodiment of the present invention;

Fig. 6 is a schematic diagram showing a head/disk assembly on which a 14-pin head and a flexible printed circuit board are mounted according to an embodiment of the present invention;

Fig. 7 is a status diagram showing that the 4-pin connector is in contact with the flexible printed circuit board according to an embodiment of the present invention; and

Figs. 8A and 8B are a cross-sectional view and a plan view of the 4-pin connector according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1 through 3, an earlier printed circuit board 10 includes a 4-pin connector 40 for transferring signals to a head/disk assembly 20, so as to revolve a spindle motor 30 and to generate the U, V, and W-phases. Further, the printed circuit board 10 includes a 14-pin connector 18 with fourteen pin holes 18a for transferring signals to a head to read and write data to and from a magnetic disk.

The 4-pin connector 40, as shown in Fig. 2, includes a cavity 44 into which a flexible printed circuit board 46 is to be inserted. The cavity 44 includes external pins 42 formed on upper and lower inner walls, which are to be connected to contact lines 48 of the flexible printed circuit board 46. Further, various kinds of integrated circuits are mounted on the printed circuit board 10.

The head/disk assembly 20 includes the spindle motor 30 mounted thereon, for revolving the magnetic disk at a constant speed. The flexible printed circuit board 46 for transferring signals to the spindle motor 30 is fixedly mounted on a side of the spindle motor 30. The flexible printed circuit board 46 includes four contact lines 48 formed at an end thereof, which are to be inserted into the cavity 44 of the 4-pin connector 40 to make a contact with the external pins 42.

Further, the head/disk assembly 20 includes a 14-pin head 28 having fourteen pins 28a formed thereon for transferring signals to the head. The pins 28a are to be inserted into the pin holes 18a of the 14-pin connector 18. The head/disk assembly 20 has a plurality of screw holes 32 for fixing the printed circuit board 10 thereto.

Now, a method for assembling the printed circuit board and the head/disk assembly will be described. First, the integrated circuits, the 4-pin connector 40, and the 14-pin connector 18 are

mounted on the printed circuit board 10. Besides, the spindle motor 30, the flexible printed circuit board 46, and the 14-pin head 28 are mounted on the head/disk assembly 20.

Thereafter, the printed circuit board 10 is put on the head/disk assembly 20, Then, the pins 28a formed on the 14-pin head 28 are inserted into the pin holes 18a of the 14-pin connector 18, thereby connecting the 14-pin head 28 to the 14-pin connector 18 so as to transfer the signals to the head. Then, the flexible printed circuit board 46 connected to the spindle motor 30 is inserted into the cavity 44 of the 4-pin connector 40. Thus, the external pins 42 formed on the cavity 44 are brought into contact with the contact lines 48 formed on the flexible printed circuit board 46, so that the signals can be transferred to the spindle motor 30. Thereafter, the printed circuit board 10 and the head/disk assembly 20 are fixed together by driving screws through the screw holes 32.

As ~~described~~ in the foregoing, in the prior art connector apparatus, a worker should manually insert the flexible printed circuit board 46 into the cavity 44 of the 4-pin connector 40. Thus, the assembling process becomes complicated and troublesome, thereby resulting into a reduction of the yield. Further, an inferior rate of the manufactured products may be increased, since the flexible printed circuit board 46 is manually inserted into the 4-pin connector.

A connector apparatus according to an embodiment of the present invention will be described in detail hereinbelow with reference to the attached drawings, in which the like reference numerals represent the like elements. Referring to Fig. 4, there is illustrated a printed circuit board 10 on which a 14-pin connector 18, various kinds of integrated circuits, and a 4-pin connector 11 are mounted according to an embodiment of the present invention. The 14-pin connector 18 includes fourteen pin holes 18a for transferring signals to a head for reading and writing data to and from a

magnetic disk. The 4-pin connector 11 includes hooklike terminals 14 and a fixing member 12 for fixing the hooklike terminals 14, and transfers signals to revolve a spindle motor 30. Further, the 4-pin connector 11 transfers signals to generate U, V, and W-phases for the spindle motor 30.

Referring to Fig. 6, there is illustrated a head/disk assembly 20 on which the spindle motor 30, a 14-pin head 28 and a flexible printed circuit board 22 are mounted according to an embodiment of the present invention. The 14-pin head 28 includes fourteen pins 28a to be inserted into the pin holes 18a of the 14-pin connector 18, to transfer signals to the head. The flexible printed circuit board 22 mounted on a side of the spindle motor 30 is to be connected to the 4-pin connector 11 to transfer signals to the spindle motor 30 for revolving the magnetic disk at a constant speed.

Referring to Fig. 5, the 4-pin connector 11 includes four hooklike (or p-shaped) terminals 14 of which each bent portion 14a is protruded downward at a predetermined angle to secure a firm contact with the flexible printed circuit board 22. The hooklike terminal 14 and the fixing member 12 are formed together in a body by a molding process. The fixing member 12 is mounted on an opening 16 formed at the printed circuit board 10. The bent portion 14a of the hooklike terminal 14 has a elasticity. Thus, the hooklike terminal 14 can secure a firm contact with the flexible printed circuit board 22 without damaging it.

Also, respective terminals 14 are bent in a p-shape so that the terminal 14 has a certain elasticity, in order to prevent a gap from being generated at the time of combining the printed circuit board 22 with the head/disk assembly 20. And, a plurality of terminals 14 are consecutively attached to the fixing member 12 in a parallel with one another, as shown in Fig. 5b.

In a second embodiment, terminal 50 installed at the printed circuit board 10 can be bent in

a c-shape, as shown in Figs. 8A and 8B. Also, the terminals 50 are crossingly attached to the fixing member 12.

Now, how to assemble the printed circuit board and the head/disk assembly will be described. First, the integrated circuits, the 4-pin connector 11, and the 14-pin connector 18 are mounted on the printed circuit board 10. Then, the fixing member 12 having the hooklike terminal 14 is fixedly mounted on the opening 16 formed at a side of the printed circuit board 10. Besides, the spindle motor 30, the flexible printed circuit board 22, and the 14-pin head 28 are mounted on the head/disk assembly 20.

Thereafter, the printed circuit board 10 is put on the head/disk assembly 20. Then, the pins 28a formed on the 14-pin head 28 are inserted into the pin holes 18a of the 14-pin connector 18, thereby connecting the 14-pin head 28 to the 14-pin connector 18 to transfer the signals to the head. At this time, the hooklike terminal 14 formed on the fixing member 12 falls down to contact the contact line 26 formed on the flexible printed board 22, as shown in Fig. 7 which illustrates a status diagram that the 4-pin connector 11 is in contact with the flexible printed circuit board 22. Specifically, the bent portion 14a of the hooklike terminal 14 automatically contacts the contact line 26 of the flexible printed board 22 upon combining the printed circuit board 10 with the head/disk assembly 20, thereby to transfer signals to the spindle motor 30. Thereafter, the printed circuit board 10 and the head/disk assembly 20 are fixed together by driving screws through screw holes 32.

As described in the foregoing, the 4-pin connector includes the hooklike terminal, so that the 4-pin connector may automatically contact the flexible printed circuit board when combining the printed circuit board with the head/disk assembly. Therefore, manufacturing throughput may

increase and an inferior rate of the manufactured products may be reduced.

The preferred embodiment is given by way of example, and as a means for explaining the use and making of the present invention. The embodiment is subject to a routine modification by those of ordinary skill in the art. The present invention is not limited to the illustrative embodiments, but is defined by the appended claims.